DESCRIPTION

CONDENSER

CROSS REFERENCE TO RELATED APPLICATIONS

This application is an application filed under 35 U.S.C. §111(a) claiming the benefit pursuant to 35 U.S.C. §119(e)(1) of the filing date of Provisional Application No. 60/540,335 filed February 2, 2004 pursuant to 35 U.S.C. §111(b).

TECHNICAL FIELD

The present invention relates to condensers, for example, for use in motor vehicle air conditioners which are refrigeration cycles to be installed in motor vehicles.

In this description and the appended claims, the upper and lower sides and the left- and right-hand sides of the drawings will be referred to respectively as "upper," "lower, "left" and "right."

BACKGROUND ART

Refrigeration cycles providing motor vehicle air conditioners have a compressor, condenser, pressure reducer (expansion valve) and evaporator. A gaseous refrigerant having a high temperature and high pressure and compressed by the compressor is condensed by the condenser to a liquid refrigerant, which is then expanded at a reduced pressure by the expansion valve and thereafter evaporated by the evaporator. Further to render the refrigeration cycle more efficient, it has been

practice in recent years to use a supercooler for supercooling the liquid refrigerant as condensed by the condenser to a temperature about 5 to about 15° C lower than the condensation temperature.

Condensers are already known which comprise a pair of headers spaced apart from each other and extending vertically, a plurality of flat refrigerant tubes arranged one above another in parallel at a spacing between the pair of headers and jointed at opposite ends to the respective headers and fins provided between respective adjacent pairs of refrigerant tubes. One of the headers has a refrigerant inlet for admitting a refrigerant into its interior therethrough, and the other header has a refrigerant outlet for causing the refrigerant to flow out therethrough. The refrigerant admitted into the above-mentioned one header through the inlet flows through all the tubes toward the other header (see, for example, the publication of JP-A No. 2001-33121). The publication discloses a heat exchanger comprising the condenser and a supercooler disposed under the condenser and comprising a pair of headers spaced apart from each other and extending vertically, a plurality of flat refrigerant tubes arranged one above another in parallel at a spacing between the pair of headers and jointed at opposite ends to the respective headers and fins provided between respective adjacent pairs of refrigerant tubes. The two headers of the condenser are joined to the respective two headers of the supercooler with a partition interposed between each joined pair of headers. A receiver tank is attached to the header of the condenser having the refrigerant outlet and

also to the header of the supercooler joined to this header so that the refrigerant flowing out of the outlet of the condenser passes through the receiver tank into the header of the supercooler.

A lubricant is used in the compressor of the refrigeration cycle for lubricating the sliding portion. For this reason, the refrigerant has inevitably incorporated therein about 3 to about 10 mass % of the compressor lubricant. The presence of the compressor lubricant in the refrigerant entails the problem of impairing the condensation performance to lower the refrigeration efficiency of the refrigeration cycle. The impairment of condensation performance becomes pronounced especially in the case of condensers of the type disclosed in the above publication and comprising a pair of headers spaced apart from each other and extending vertically, a plurality of flat refrigerant tubes arranged one above another in parallel at a spacing between the pair of headers and jointed at opposite ends to the respective headers and fins provided between respective adjacent pairs of refrigerant tubes, one of the headers having a refrigerant inlet for admitting a refrigerant into its interior therethrough, the other header having a refrigerant outlet for causing the refrigerant to flow out therethrough, the refrigerant as admitted into the above-mentioned one header through the inlet being flowable through all the tubes toward the other header.

An object of the present invention is to solve the above problem and to provide a condenser which can be prevented from becoming impaired in condensation performance even when the

refrigerant has a compressor lubricant incorporated therein.

DISCLOSURE OF THE INVENTION

To solve the above problem, we have conducted intensive research and found that with the condenser disclosed in the above publication, the number of refrigerant tubes positioned below the center of the refrigerant inlet with respect to the vertical direction exerts influence on the impairment of condensation performance in the case where the refrigerant contains the compressor lubricant admixed therewith. Stated more specifically, if the number of refrigerant tubes is excessive, the compressor lubricant settles to the lower portion of the inlet header to flow mainly into the refrigerant tubes positioned in the lower portion, consequently reducing the amount of refrigerant flowing through the tubes in the lower portion and decreasing the number of refrigerant tubes contributing to the condensation.

The present invention, which has been accomplished based on this finding, comprises the following modes.

1) A condenser comprising an inlet header and an outlet header spaced apart from each other in a left-right direction and extending vertically, a plurality of flat refrigerant tubes arranged one above another in parallel at a spacing between the two headers and jointed at opposite ends thereof to the respective headers and fins provided between respective adjacent pairs of refrigerant tubes, the inlet header having a refrigerant inlet for admitting a refrigerant into interior thereof therethrough, the outlet header having a refrigerant outlet

for causing the refrigerant to flow out therethrough, the refrigerant as admitted into the inlet header through the inlet being flowable through all the refrigerant tubes toward the outlet header, the number of refrigerant tubes positioned below the center of the refrigerant inlet with respect to the vertical direction being up to 21.

2) A condenser according to par. 1) wherein the number of refrigerant tubes positioned below the center of the refrigerant inlet with respect to the vertical direction is up to 7.

3) A condenser according to par. 1) which has 22 to 70 refrigerant tubes in total.

4) A condenser according to par. 1) which is 150 to 500 mm in height as the condenser is seen from the front, 200 to 800 mm in left-to-right width, 0.8 to 3 mm in the height of the refrigerant tubes, and 4.5 to 12 mm in the spacing between each adjacent pair of refrigerant tubes.

5) A condenser according to par. 1) wherein the refrigerant to be used contains 3 to 10 mass % of a compressor lubricant admixed therewith.

6) A condenser comprising two headers spaced apart from each other in a left-right direction and extending vertically, a plurality of flat refrigerant tubes arranged one above another in parallel at a spacing between the two headers and jointed at opposite ends thereof to the respective headers and fins provided between respective adjacent pairs of refrigerant tubes, a plurality of tube groups arranged one above another in parallel and each comprising some of the refrigerant tubes

as arranged one above another in parallel in succession, a refrigerant being flowable in the same direction through all the refrigerant tubes constituting each of the tube groups, each adjacent pair of tube groups being different in the direction of flow of the refrigerant therethrough, one of the headers having a refrigerant inlet at a level corresponding to the tube group at an upper end for admitting the refrigerant into interior thereof therethrough, said one header having the refrigerant inlet or the other header being provided with a refrigerant outlet at a level corresponding to the tube group at a lower end for causing the refrigerant to flow out therethrough, the refrigerant as admitted through the inlet being flowable through the refrigerant tubes of all the tube groups so as to be discharged through the outlet, the number of refrigerant tubes included in the upper-end tube group and positioned below the center of the refrigerant inlet with respect to the vertical direction being up to 21.

7) A condenser according to par. 6) wherein the number of refrigerant tubes included in the upper-end tube group and positioned below the center of the refrigerant inlet with respect to the vertical direction is up to 7.

8) A condenser according to par. 6) wherein the upper-end tube groups has 22 to 70 refrigerant tubes in total.

9) A condenser according to par. 6) which is 200 to 800 mm in left-to-right width, 0.8 to 3 mm in the height of the refrigerant tubes, 4.5 to 12 mm in the spacing between each adjacent pair of refrigerant tubes, and 150 to 500 mm in the height of the upper-end tube group as it is seen from the front.

10) A condenser according to par. 6) wherein the refrigerant to be used contains 3 to 10 mass % of a compressor lubricant admixed therewith.

11) A heat exchanger having a condenser portion comprising a condenser according to par. 1), and a supercooler portion disposed under the condenser portion and comprising a pair of headers spaced apart from each other in a left-right direction and extending vertically, a plurality of flat refrigerant tubes arranged one above another in parallel at a spacing between the two headers and jointed at opposite ends thereof to the respective headers and fins provided between respective adjacent pairs of refrigerant tubes, the outlet header of the condenser portion being provided with one of the headers of the supercooler portion with a partition interposed therebetween, the inlet header of the condenser portion being provided with the other header of the supercooler portion with a partition interposed therebetween, a receiver tank being attached to both the outlet header of the condenser portion and said one header of the supercooler portion, the refrigerant as discharged from the refrigerant outlet of the condenser portion being flowable into said one header of the supercooler portion through the receiver tank.

12) A heat exchanger having a condenser portion comprising a condenser according to par. 6), and a supercooler portion disposed under the condenser portion and comprising a pair of headers spaced apart from each other in a left-right direction and extending vertically, a plurality of flat refrigerant tubes arranged one above another in parallel at

a spacing between the two headers and jointed at opposite ends thereof to the respective headers and fins provided between respective adjacent pairs of refrigerant tubes, one of the headers having the refrigerant outlet and included in the condenser portion being provided with one of the headers of the supercooler portion with a partition interposed therebetween, the other header of the condenser portion being provided with the other header of the supercooler portion with a partition interposed therebetween, a receiver tank being attached to both the header having the refrigerant outlet and included in the condenser portion and said one header of the supercooler portion, the refrigerant as discharged from the refrigerant outlet of the condenser portion being flowable into said one header of the supercooler portion through the receiver tank.

13) A heat exchanger according to par. 11) or 12) wherein the refrigerant to be used contains 3 to 10 mass % of a compressor lubricant admixed therewith.

14) A refrigeration cycle having a compressor, a condenser according to par. 1) or 6), a pressure reducer and an evaporator, the refrigeration cycle being adapted for use with a refrigerant containing 3 to 10 mass % of a compressor lubricant admixed therewith.

15) A vehicle comprising a refrigeration cycle according to par. 14) as an air conditioner.

16) A refrigeration cycle having a compressor, a heat exchanger according to par. 11) or 12), a pressure reducer and an evaporator, the refrigeration cycle being adapted for

use with a refrigerant containing 3 to 10 mass % of a compressor lubricant admixed therewith.

17) A vehicle comprising a refrigeration cycle according to par. 16) as an air conditioner.

The condenser described in par. 1) has up to 21 refrigerant tubes below the center, with respect to the vertical direction, of the refrigerant inlet, so that even when the refrigerant contains a compressor lubricant, the refrigerant readily flows also into the refrigerant tubes which are positioned in the lower portion. As a result, a relatively large number of refrigerant tubes contribute to condensation to mitigate the impairment of condensation performance.

The condenser according to par. 2) is more effective to reduce the impairment of condensation performance.

The condenser according to par. 1) produces a remarkable effect when the total number of refrigerant tubes is 22 to 70 as described in par. 3).

The condenser according to par. 1) produces a remarkable effect when the refrigerant contains 3 to 10 mass % of compressor lubricant as described in par. 5).

With the condenser described in par. 6), the upper-end tube group has up to 21 refrigerant tubes below the center of the refrigerant inlet with respect to the vertical direction, so that even when containing the compressor lubricant, refrigerant readily flows into the refrigerant tubes positioned in the lower portion of the upper-end tube group, consequently increasing the number of tubes contributing to condensation to diminish the impairment of condensation performance.

The condenser according to par. 7) enables the upper-end tube group to more effectively suppress the impairment of condensation performance.

The condenser according to par. 6) produces a remarkable effect when the total number of refrigerant tubes constituting the upper-end tube group is 22 to 70 as described in par. 8).

The condenser according to pars. 6) produces a remarkable effect when the refrigerant contains 3 to 10 mass % of compressor lubricant as described in par. 10).

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an overall front view showing an embodiment of heat exchanger comprising a condenser of the invention. FIG. 2 is a sectional view showing on an enlarged scale the portion of a refrigerant inlet member of the condenser of the heat exchanger of FIG. 1. FIG. 3 is an overall front view showing a heat exchanger of Embodiment 2. FIG. 4 is an overall front view showing a heat exchanger of Comparative Example. FIG. 5 is an overall front view showing another embodiment of the invention.

BEST MODE OF CARRYING OUT THE INVENTION

Embodiments of the present invention will be described below with reference to the drawings. Throughout the drawings, like parts will be designated by like reference numerals and will not be described repeatedly.

According to a first embodiment, the invention is embodied as a heat exchanger comprising a condenser and supercooler

which are assembled into a unit. In the following description, the term aluminum includes aluminum alloys in addition to pure aluminum.

FIG. 1 shows the overall construction of a heat exchanger having a condenser portion comprising a condenser of the invention, and FIG. 2 shows the construction of the main portion thereof.

With reference to FIG. 1, the heat exchanger 1 comprises a condenser portion 2 and a supercooler portion 3 which are arranged in a vertical plane, with the supercooler portion 3 positioned under the condenser portion 2. A receiver tank 4 is attached to both the condenser portion 2 and the supercooler portion 3.

The condenser portion 2 comprises an inlet header 5 of aluminum and an outlet header 6 of aluminum which are spaced apart from each other and extending vertically, a plurality of flat refrigerant tubes 7 of aluminum arranged one above another in parallel at a spacing between the two headers 5, 6 and jointed at opposite ends to the respective headers 5, 6, and corrugated aluminum fins 8 provided between and brazed to respective adjacent pairs of refrigerant tubes 7. An aluminum side plate 9 is disposed above and spaced apart from the refrigerant tube 7 at the upper end of the tube arrangement. A corrugated aluminum fin 8 is also provided between and brazed to the side plate 9 and the end tube 7.

The supercooler portion 3 comprises a first header 11 of aluminum and a second header 12 of aluminum which are spaced apart from each other and extending vertically, a plurality

of flat refrigerant tubes 13 of aluminum arranged one above another in parallel at a spacing between the two headers 11, 12 and jointed at opposite ends to the respective headers 11, 12 and corrugated aluminum fins 14 provided between and brazed to respective adjacent pairs of refrigerant tubes 13. An aluminum side plate 15 is disposed below and spaced apart from the refrigerant tube 13 at the lower end of the tube arrangement. A corrugated aluminum fin 14 is also provided between and brazed to the side plate 15 and the end tube 13.

Although not shown, the refrigerant tubes 7, 13 of the condenser portion 2 and the supercooler portion 3 each have a plurality of refrigerant channels of noncircular cross section formed in parallel. The refrigerant tubes 7, 13 are preferably 0.2 to 1.6 mm in hydraulic diameter Dh. When the refrigerant tube 7 or 13 having a plurality of refrigerant channels of noncircular cross section is regarded as a circular tube having a single channel, the equivalent diameter of this channel is referred to as the hydraulic diameter Dh, which is defined by the following equation.

$$Dh = 4\ m$$

wherein m is Ac/Pi wherein Ac is the total cross sectional area of the refrigerant channels, and Pi is the inner circumferential length of the cross section of the refrigerant channels.

The pair of headers 5, 6 of the condenser portion 2 and the pair of headers 11, 12 of the supercooler portion 3 are provided by a pair of left and right tanks 16 extending vertically, closed at opposite ends and each having a partition

17 disposed at a lower portion thereof for dividing the interior thereof. The portion of the right tank 16 above the partition 17 serves as the inlet header 5 of the condenser portion 2, and the tank portion below the partition 17 as the second header 12 of the supercooler portion 3. The portion of the left tank 16 above the partition 17 serves as the outlet header 6 of the condenser portion 2, and the tank portion below the partition 17 as the first header 11 of the supercooler portion 3.

The inlet header 5 of the condenser portion 2 has joined thereto a refrigerant inlet member 18 for admitting therethrough the refrigerant into the header. The outlet header 6 has joined thereto a refrigerant outlet member 19 for causing the refrigerant to flow out of the interior of the header therethrough into the receiver tank 4. As shown in FIG. 2, the inlet member 18 of the condenser 2 has an insert portion 18a to be inserted into a refrigerant inlet 23 formed in the peripheral wall of the inlet header 5 and provides a refrigerant passageway 18b having an open end at the inner end of the insert portion 18a and another open end at the end of the member 18 positioned outside the inlet header 5.

The first header 11 of the supercooler portion 3 has joined thereto a refrigerant inlet member 21 for admitting therethrough the refrigerant into the header from the receiver tank 4. The second header 12 has joined thereto a refrigerant outlet member 22 for causing the refrigerant to flow out of the header therethrough.

Although not shown, the outlet member 22 of the supercooler portion 3 has the same construction as the inlet member 18

and is joined to a refrigerant outlet (not shown) formed in the second header 12 as is the case with the inlet member 18. The outlet member 19 of the condenser portion 2 is joined to the outlet header 6 and the receiver tank 4 so as to cause a refrigerant outlet (not shown) formed in the lower end of the outlet header 6 to communicate with a refrigerant inlet (not shown) of the receiver tank 4. The inlet member 21 of the supercooler portion 3 is joined to the first header 11 and the receiver tank 4 so as to cause a refrigerant outlet (not shown) of the receiver tank 4 to communicate with a refrigerant inlet (not shown) formed in the first header 11.

The receiver tank 4 is internally provided with a filter for removing extraneous matter from the refrigerant and a dryer (neither shown) for absorbing water from the refrigerant.

A gaseous refrigerant having a high temperature and high pressure and compressed by a compressor is admitted into the inlet header 5 through the inlet member 18 and then through the inlet 23 of the condenser portion 2 and, is condensed while flowing leftward through all the refrigerant tubes 7, flows into the outlet header 6, and then flows through the outlet and the outlet member 19 into the receiver tank 4, in which extraneous matter and water are removed from the refrigerant. The refrigerant thereafter flows into the first header 11 of the supercooler portion 3 through the inlet member 21, is supercooled to 5 to 15° C while flowing rightward through all the refrigerant tubes 13, flows into the outlet header 12 and is sent to an evaporator via the outlet member 22 and an expansion valve.

The condenser portion 2 is, for example, 150 to 500 mm in height H as it is seen from the front, the refrigerant tubes 7 are 200 to 800 mm in width W in the lengthwise (left-right) direction and 0.8 to 3 mm in height, and the spacing (fin height) between each adjacent pair of refrigerant tubes 7 is 4.5 to 12 mm. The total number of refrigerant tubes 7 in the condenser portion 2 is 22 to 70. Below the center O (see FIG. 2), with respect to the vertical direction, of the refrigerant inlet 23 of the inlet header 5 of the condenser portion 2, the condenser portion 2 has up to 21 refrigerant tubes 7. The number of refrigerant tubes 7 positioned below the center O of the inlet 23 with respect to the vertical direction is preferably up to 16, more preferably up to 7.

The heat exchanger 1 described is adapted to provide a refrigerant cycle along with a compressor wherein a lubricant is used, a pressure reducer (expansion valve) and an evaporator. Accordingly, the refrigerant to be circulated through the refrigerant cycle has incorporated therein 3 to 10 mass % of the compressor lubricant. Such a refrigerant cycle is used as an air conditioner in motor vehicles or like vehicles.

Given below along with a comparative example are specific examples of the invention wherein heat exchangers of the construction described above were used.

Example 1

Used in this example was a heat exchanger 1 which was composed of a condenser portion 2 and a supercooler portion 3 having a combined overall height of 360 mm and an overall left-to-right width of 600 mm, and which was 300 mm in the

height H of the condenser portion 2 and 43 in the total number of refrigerant tubes 7 of the condenser portion 2, 7 in the total number of refrigerant tubes 13 of the supercooler portion 3 and 21 in the number of refrigerant tubes 7 existing below the center, with respect to the vertical direction, of the refrigerant inlet 23 of the condenser portion 2 (see FIG. 1).

Example 2

Used in this example was a heat exchanger 1A having the same construction as in Example 1 except that the condenser portion 2 had 7 refrigerant tubes 7 below the center O, with respect to the vertical direction, of the refrigerant inlet 23 (see FIG. 3).

Comparative Example

Used in this example was a heat exchanger 1B having the same construction as in Example 1 except that the condenser portion 2 had 40 refrigerant tubes 7 below the center O, with respect to the vertical direction, of the refrigerant inlet 23 (see FIG. 4).

Evaluation Test

Using these heat exchangers 1, 1A, 1B, and compressors, expansion valves and evaporators, refrigeration cycles were assembled, and the cycles were tested for operation under simulated running conditions corresponding to a vehicle speed of 40 km/h. The air to be introduced into the clearances between the adjacent pairs of refrigerant tubes 7 of the condenser portion 2 had a temperature, i.e., inlet air temperature T, of 40° C, and a flow velocity of 2 m/s.

The average condensation temperature Tc was measured,

and the difference Tx between the average condensation temperature Tc and the inlet air temperature T was calculated. Tabled 1 shows the result. Also calculated was 1/Tx, and the calculated value was expressed relative to the 1/Tx value of Comparative Example which was taken as 100. Table 1 shows the result. The greater the 1/Tx value, the better the performance.

Table 1

	Inlet air temp. (° C)	Average condensation temp. Tc (° C)	Difference Tx (° C)	1/Tx
Example 1	40	56.95	16.95	109
Example 2	40	56.78	16.78	110
Comp. Ex.	40	58.53	18.53	100

The results given in Table 1 show that the difference between the average condensation temperature Tc and the inlet air temperature T was in the order of Example 2 < Example 1 < Comparative Example. This indicates that the condenser portion 2 of the heat exchanger 1A of Example 2 exhibited the highest performance.

During the above operation test, the temperature of the area of the condenser portion 2 was measured by a thermotracer. In the condenser portion 2 of the heat exchanger of Example 1, a relatively small area X indicated by chain lines in FIG. 1 was found low in temperature, revealing that a substantial amount of refrigerant fails to flow through the refrigerant tubes 7 in this area X. The heat exchanger 1A of Example 2

had no area of low temperature, this indicating that the refrigerant flows through all the refrigerant tubes 7 generally uniformly. In the case of the heat exchanger 1B of Comparative Example, a larger area Y than in the case of Example 1 indicated by chain lines was found to be low in temperature. This shows that the refrigerant tubes 7 in this area failed to pass a substantial amount of refrigerant therethrough.

FIG. 5 shows another embodiment of the present invention.

The heat exchanger 30 shown in FIG. 5 has a condenser portion 31 comprising a condenser of the invention and having headers neither of which is distinguished as an inlet header or an outlet header, so that the right header (inlet header 5) of the condenser portion 2 in the heat exchanger 1 of FIG. 1 will be referred to as a first header 5, and the left header (outlet header 6) as a second header 6.

The condenser portion 31 of the heat exchanger 30 has a first aluminum partition 32 provided inside the first header 5 at a position above the midportion thereof, and a second partition 33 disposed inside the second header 6 at a position below the midportion thereof. The condenser portion 31 has groups 34, 35 and 36 of refrigerant tubes 7 provided respectively in the portion above the first partition 32, the portion between the two partitions 32, 33 and the portion below the second partition 33, the refrigerant tubes of each group being arranged one above another in succession. The tube groups 34, 35, 36 are successively decreased from above downward in the number of constituent refrigerant tubes 7. The refrigerant flows through all tubes 7 of each of group 34, 35 or 36 in the same

direction, and each adjacent pair of groups 34, 35 (35, 36) are different in the direction of flow of the refrigerant.

A refrigerant inlet 23 like the one in the condenser portion 2 of the heat exchanger 1 shown in FIG. 1 is provided at a level above the first partition 32 of the first header 5 and corresponding to a lower portion of the upper-end tube group 34, and a refrigerant inlet member 18 is joined to the inlet 23. The upper-end tube group 34 has up to 21 refrigerant tubes 7 below the center O of the refrigerant inlet 23 with respect to the vertical direction. The number of refrigerant tubes 7 included in the upper-end tube group 34 and positioned below the center O of the inlet 23 with respect to the vertical direction is preferably up to 16, and more preferably up to 7.

A refrigerant outlet like the one in the condenser portion 2 of the heat exchanger 1 shown in FIG. 1 is provided at a level below the second partition 33 of the second header 6 and corresponding to the midportion of the lower-end tube group 36, and a refrigerant outlet member 19 is joined to the outlet.

A receiver tank 4 is attached to both a portion of the second header 6 of the condenser portion 31 below the second partition 33 thereof and a first header 11 of a supercooler portion 3.

Through the inlet member 18 and then through the inlet 23 of the condenser portion 2, a gaseous refrigerant having a high temperature and high pressure and compressed by a compressor is admitted into the first header 5 at a portion thereof above the first partition 32, is condensed while flowing zigzag through the units of tube groups 34, 35, 36 in the condenser

portion 31, then flows into the portion of the second header 6 below the second partition 33, and flows out of the outlet through the outlet member 19 into the receiver tank 4, in which extraneous matter and water are removed from the refrigerant. The refrigerant thereafter flows through the inlet member 21 into the first header 11 of the supercooler portion 3, is supercooled to 5 to 15° C while flowing rightward through all the refrigerant tubes 13, flows into the second header 12 and is then sent to an evaporator through the outlet member 22 and via an expansion valve.

The heat exchanger 30 is the same as the heat exchanger 1 shown in FIG. 1 with respect to the width of the refrigerant tubes 7 of the condenser portion 31 in the lengthwise (left-right) direction, the height of the refrigerant tubes 7, the spacing (fin height) between each adjacent pair of refrigerant tubes 7. the total number of refrigerant tubes 7 in the condenser portion 31 and the hydraulic diameter Dh of the refrigerant tubes 7. The upper-end rube group 34 is preferably 150 to 500 mm in height H1 as it is seen from the front. The heat exchanger 30 otherwise has the same construction as the exchanger 1 shown in FIG. 1.

With the heat exchanger 30 shown in FIG. 1, the number of tube groups is suitably variable insofar as it is not smaller than two. The number of tube groups is altered by suitably varying the number of partitions to be provided inside the first header 5 and the number of partitions to be provided inside the second header 6. If the number of tube groups is an odd number, a refrigerant inlet member having a refrigerant

inlet is joined to the first header 5 at a portion thereof corresponding to the upper-end tube group, while if the number is an even number, the refrigerant inlet member having a refrigerant inlet is joined to the second header 6 at a portion thereof corresponding to the upper-end tube group.

Although two embodiments have been described above with reference to the case wherein a condenser portion comprising the condenser of the invention and a supercooler portion are assembled into a heat exchanger, the condenser of the invention is of course usable as a single condenser which is separate from a supercooler.

INDUSTRIAL APPLICABILITY

The present invention provides a condenser, for example, for use in motor vehicle air conditioners which are refrigeration cycles to be installed in motor vehicles. The condenser of the invention can be prevented from becoming impaired in condensation performance in the case where the refrigerant has a compressor lubricant incorporated therein.